

REMARKS

The Applicants respectfully request reconsideration in view of the following remarks. Claims 1-6 and 18-29 are now pending. Claims 7-17 were previously canceled from the application in paper number 10. Claim 4 has been amended in this response. Support for newly added claims 18-29 can be found in the specification as follows: (1) claim 18: page 7, lines 3-15, page 12, line 29, and page 12, lines 20-21; (2) claim 19: page 15, lines 1-4; (3) claim 20: page 15, lines 6 & 7; (4) claims 21-24: page 14, lines 18-22; (5) claim 25: page 7, lines 3-7; (6) claim 26: page 7, lines 7-15 and page 11, lines 15-23; (7) claim 27: page 7, lines 11-15 and page 11, lines 20-23; (8) claim 28: page 12, lines 10-18 and page 13, lines 11-12; and (9) claim 29: page 7, lines 3-15.

Objection

The Examiner objected to the word graphene on pages 14 and 15 of the specification. The phrase graphene layers is described on page 4, lines 10-12 of the specification. It is Applicants' position that the cited passage in the specification will provide the Examiner with a proper understanding of the term graphene. Additionally for the benefit of the Examiner, Applicants have attached a relevant section of *Introduction to Carbon Technologies*, which includes a description of graphene layers in agreement with Applicants' use of the term in the specification. In light of the above remarks and the attachment, Applicants request that the Examiner withdraw the objection to the specification.

Section 112, Second Paragraph Rejection

Claims 1-6 were rejected under 35 U.S.C. §112, second paragraph as being indefinite for failing to particularly point out and distinctly claim the subject matter which the applicants

regard as the invention. The basis for the rejection was the use of the term “graphene” in claims 1 and 3.

In light of the above discussion regarding the term graphene, Applicants respectfully disagree that claims 1-6 are indefinite. Applicants assert that the claims as pending do satisfy the requirements of 35 U.S.C. §112, second paragraph. This rejection should be withdrawn for at least that the scope of the claims 1-6 are clear to a person of ordinary skill in the art.

Prior Art Rejections

The Examiner rejected claims 1-6 under 35 U.S.C. § 103(a) as being obvious over Missele (U.S. Patent No. 5,523,260) in view of Hyman et al. (U.S. Patent No. 5,467,814). In the action, the Examiner alleges that Missele discloses that it is known to employ a graphitic carbon heat sink to remove heat from and cool an electronic component. According to the Examiner the Hyman et al. reference discloses that it is known to form a heat transfer device or element via a process wherein a plurality of directionally oriented graphite fibers are adhesively joined together using an epoxy adhesive to form a laminate composite. The Examiner opined that it would have been obvious to one of ordinary skill in the art to employ the heat dissipator or heat sink of Hyman et al. in conjunction with the invention of Missele. It is inferred by Applicants that the Examiner cites to column 1, lines 61-64 and column 2, lines 103 of Hyman et al. for motivation to combine the references or to modify the teachings of one reference in light of the teachings of the other reference.

To establish a *prima facie* case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the reference or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally the prior art reference (or references when combined) must teach or suggest all the claim limitations. The teaching or suggestion to make the claimed combination and the reasonable

expectation of success must both be found in the prior art, and not based on applicant's disclosure. *In re Vaeck*, 947 F.2d 488, 20 USPQ2d 1438 (Fed. Cir. 1991).

The rejection is improper for at least the reason that the combination of references put forth by the Examiner does not teach each and every element of the claimed invention. For example the combination of references does not teach, suggest, or disclose a laminate comprising a plurality of flexible graphite sheets.

It is believed by Applicants that the Examiner in making the combination of references is alleging that the graphite fiber-epoxy composite of Hyman et al. is the same as the claimed laminate comprising a plurality of flexible graphite sheets. The flexible graphite sheet of the claimed invention is not the same as the graphite fibers of Hyman et al. The flexible graphite sheet is formed by compressing numerous small flakes of natural graphite that have been intercalated and expanded. See pages 7-11 for a description for a more detailed description of how flexible graphite sheet is formed. The flexible graphite sheet is a composite of individual expanded graphite particles compressed together. The individual expanded graphite particles do not have a continuous structure and rely on physical contact with an adjacent expanded graphite particle to form the sheet. Additionally attached page 1012 of *Kirk-Othmer Encyclopedia of Chemical Technology* 4th Ed., Volume 4 is incorporated herein by reference for further understanding on flexible graphite sheet.

In comparison, the graphite fiber of Hyman et al. is not considered by a person of ordinary skill in the art to be the same as a flexible graphite sheet or the precursors for such sheet. It is commonly understood that graphite fibers are a synthetic graphite product being formed from raw materials such as PAN or pitch. The fibers are typically polymeric structures that contain continuous sheets of graphite. An object in forming a graphite fiber is to produce a single strand of a single material. Neither the fiber nor the material is intercalated or expanded like the natural graphite flakes. A matter of fact, intercalating or expanding the fiber would hinder the use of the fiber for its intended purpose because these two steps would reduce the

homogeneity of the structure of the fiber and reduce the strength of the fiber. The attached references of page 575 of *Hawley's Condensed Chemical Dictionary* 12th Ed. and page 1 of *Kirk-Othmer Encyclopedia of Chemical Technology* 4th Ed., Volume 5 are incorporated herein by reference for additional background regarding graphite fiber.

Additionally, many of the properties of the flexible graphite sheet or its precursor are not the same as that of a graphite fiber. As stated in the specification, the flexible graphite sheet as well as the expanded graphite is anisotropic, properties that are at least bi-directional. Graphite fibers are considered unidirectional having properties that are only in the length direction of the fiber.

Furthermore, a flexible graphite sheet will not have anywhere near as high as a tensile strength as the graphite fiber. Typical flexible graphite sheets have a tensile strength of about 750 psi, with an upper reported limit of about 10,000 psi. From the *Hawley's* attachment, the tensile strength of a graphite fiber is at least 50,000 psi. The Hyman et al. reference reports to use a graphite fiber having a tensile strength of at least 500,000 psi. Column 2, line 46 of Hyman et al. For additional support on this issue, Applicants have attached a brochure from BP Amoco that includes the tensile strength of the fibers cited in Hyman et al. The P 120 fiber has a reported tensile strength of 350,000 psi and the T 300 fiber has a reported tensile strength of 545,000 psi.

Additionally, in light of the teachings of Hyman et al. that the fibers need to provide high structural strength to the composite (See column 2, lines 43-47, and column 3, lines 9-23), it is unclear why a person of ordinary skill in the art would use a sheet of flexible graphite with a tensile strength of the less than at least 35 times that of the weakest fiber in place of the fibers taught in Hyman et al.

As for the expanded graphite flake, exhibits A and B are attached to illustrate the physical differences between expanded graphite and graphite fibers. As shown in the attached exhibits, the expanded graphite flake has a foam like form and, as stated before, it does not have a

continuous structure. Unlike the expanded graphite flake, graphite fibers do have a continuous structure and not the aforementioned foam like shape. Two excerpts from *Carbon Fibers* 3rd Ed. are attached to illustrate this point. Figure 24 on page 118 of *Carbon Fibers* schematically illustrates carbon fibers in a ribbon or woven format. On page 142 of *Carbon Fibers* a perspective view of an Amoco P 100 fiber is shown. (P 100 is the predecessor to the P 120 fiber disclosed in Hyman et al.) As shown in figure 39, the graphite fiber is a solid article with continuous structure, devoid of the voids shown in the exhibits.

Also the expanded graphite, it is thermally conductive in the width direction of the expanded graphite particle and nominally thermally conductive in its length direction. Whereas, the graphite fiber is the opposite, being highly thermally conductive in the length of the graphite fiber. As for tensile strength, the expanded graphite has a lower tensile strength than a sheet of flexible graphite. Thus, the tensile strength of the expanded graphite is even lower in comparison of a graphite fiber to a flexible graphite sheet.

In light of the above remarks and the attached documentation, a graphite fiber is not the same as a flexible graphite sheet or a precursor for a flexible graphite sheet. At least for this reason, the combination cited by the Examiner does not teach each and every element of the claimed invention and the rejection is improper. Therefore, Applicants respectfully request that the Examiner withdraw the rejection of claims 1-6 based on the cited art.


A petition for a one-month extension is attached. If there are any additional fees due in connection with the filing of this response, including any fees required for an additional extension of time under 37 C.F.R. 1.136, such an extension is requested and the Commissioner is authorized to charge or credit any overpayment to Deposit Account No. 50-1202.

SERIAL NO: 09/888,972

ATTORNEY DOCKET NO.: P1045

For the reasons set forth above, Applicants believe that the claims are patentable over the references cited and applied by the Examiner and a prompt and favorable action is solicited. The applicants believe that these claims are in condition for allowance, however, if the Examiner disagrees, the applicants respectfully request that the Examiner telephone the undersigned.

Respectfully submitted,
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Marked Up Version Showing Changes

Please amend the claims as follows:

4.(amended) The process of claim ~~3~~ 2 wherein the graphene layers of the flexible graphite sheets which make up the laminate are subjected to the application of pressure prior to the formation of the laminate, by increasing the pressure applied to the sheets during the calendering process.